work of the atmosphere, of overground and underground waters, and of snow and ice, vulcanism and the movements of the earth's crust, and the nature and arrangement of rock-types and rock-masses. The second part, of some 400 pages, deals with historical geology. This should be of great service to students, especially those outside America, by providing a generalised, but not too brief account of the stratigraphy of North America, a subject of which no very satisfactory digest has hitherto been available. A classification of geological time into five eras is adopted — archeozoic, proterozoic, paleozoic, mesozoic, and cenozoic—and the description of the first of these is preceded by a discussion of the origin and constitution of the earth on the Laplacian and planetesimal theories respectively.

This part of the book is illustrated by numerous maps, sections, and figures of fossils, most of which are good. But the eighteen full-page maps showing the outcrop, underground extent, and eroded areas of the several systems in America are so largely conjectural that it is a question whether a single geological map in colours showing the actual outcrops, as at present known, would not have been more suitable and useful in a book of this kind. Many of the sections, especially those taken from the publications of the U.S. Geological Survey, seem unnecessarily detailed, and have suffered by reduction: their educational value might have been greater if they had been redrawn in a more diagrammatic form.

The book is an admirable statement of physical and stratigraphical geology from the American point of view, and will doubtless be warmly welcomed and much used by students and general readers for many years to come.

(2) This volume is based upon the courses in geology which the authors have been giving, for some years past, to students of engineering. The scope of the work is wide, and its treatment fuller than in most books on the subject which have hitherto appeared.

Chapters dealing with the minerals of rocks, and with the occurrence and origin of the rocks themselves, are followed by one on tectonics and metamorphism, in which the importance of jointing, cleavage, folding, faulting, and other rock structures in engineering operations are fully dealt with. This is succeeded by a chapter on rock-weathering and the formation of soils. The next two deal with surface and underground waters, and here the geological principles underlying water-supply, drainage, the sinking of wells, the construction of reservoirs, etc., are thoroughly discussed. A short chapter on landslides follows, and then two on the action of waves and currents in seas and lakes, and its bearing upon coastal erosion and harbour construction. The origin and economic uses of glacial deposits are then described. The remaining chapters deal with specific materials of importance to the civil or mining engineer, such as building stone, lime, cement, plaster, clay, fuels, road foundations, and road metals; the last chapter, intended for the metal miner, consists of a short account of the general principles of ore-formation and of the geology of certain of the useful metals. This, from limits of space, is necessarily somewhat inadequate.

At the end of each chapter useful references are given to additional literature on the subject therein dealt with. The book is well illustrated, and there is a triple index referring to subjects, localities, and authors. It is undoubtedly a useful addition to what has already been written on engineering geology. It is eminently practical, and its very direct application to a great variety of engineering problems should commend it, not only to students, but also to engineers in actual practice.

C. G. C.

APPLIED ELECTRICITY.

(1) *Alternating Currents and Alternating Current Machinery.* By Prof. D. C. Jackson and Dr. J. P. Jackson. New edition, rewritten and enlarged. Pp. ix + 968. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1913.) Price 23*s*. net.

(2) *The Elements of Electricity.* By Prof. Wirt Robinson. Second edition. Pp. xv + 596. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1914.) Price 10*s*. 6*d*. net.

(1) IN its thirteen chapters, this work covers fairly thoroughly the ground suggested by its title; in most places the theoretical side is treated with at least sufficient detail, but the constructional side has also received a good share of attention. We should have liked a somewhat fuller discussion of the motor-converter, and think the time is also ripe for some mention of the Kapp and Scherbius phase advancers and of the Hunt Cascade motor. The first few chapters impressed us very favourably, and although we were somewhat disappointed with the later chapters, we consider the book a good one, which will be of service to advanced students.

From the very beginning, the authors use the complex quantity, but it is not until chapter v. that we get a full explanation of the method. This chapter is an excellent one, but should have come earlier. The numerical examples given (single-phase problems) show well the use of the complex quantity, but are scarcely sufficiently difficult to bring out any advantages for it, as the actual working is exactly the same as would be done by an intelligent student who had never heard of the Steinmetz methods. In a later chapter on polyphase circuits, other examples occur in which algebraic processes have to be carried out before substituting numerical values. In these the advantages become more obvious.

The authors do not quite attain to the standard set in their preface of "avoiding the error of presenting unnecessary formulas." On the contrary, we feel that a formula has been inserted wherever the slightest excuse for it can be found, even when the same formula has been given several times already.

The facts of nature do not depend on a particular choice of units, or, indeed, upon the existence of any units at all. It is therefore quite superfluous to introduce units into the mathematical treatment of these facts. Why will all authors not let their symbols stand for the *thing* itself, instead of for the number of times it contains some particular unit? The length of a foot-rule remains the same whether we call it "one foot," "12 inches," 30·48 . . . centimetres, or 304·8 . . . millimetres. The symbol L can just as well represent the length itself as any of these numbers, and in this way we are freed from the necessity of continually stopping to name the units to be employed, and from the irritating repetition of numbers such as 10^8, $4\pi \div 10$, 60, 746, 33,000, and so forth, which have nothing whatever to do with the laws, but arise from some particular (and unfortunate, although customary) choice of units, and thus distract attention from the real point under discussion. In the book under review, pages and pages might have been saved in this way.

Taking the book as a whole, the explanations are not as clear and concise as they might be; indeed, we found it exceedingly difficult to follow some of them. Several hydraulic analogies are given, but we are very doubtful whether these are really helpful, because the laws of hydro-dynamics have to be strained to make them fit the electrical case, and not infrequently the student's knowledge of that subject is less than of electricity.

(2) Except that part v. goes rather more fully into the technical side than is customary in books with its title, this book covers the well-worn ground of elementary magnetism and electricity. It contains little that is original in matter or in method, and its mathematics is uneven.

Many of the statements given ought to have attached to them the qualifying conditions under which alone they are true. Parts of the book are painfully laboured over some small point, while others are extremely superficial and betray a lack of insight into the true inwardness of the matter discussed.

In our science we have many traditions and dogmas from which we must ultimately break loose, and the sooner this is recognised by the writers of elementary text-books the better it will be for our students. What was best half a century or more ago is not necessarily even good now. Consider the electrostatic and electromagnetic systems of definitions. In chapter 39 the absurdity of the dimensional relations which arise from these definitions is pointed out; but in the other chapters which form the real book, we still have the old Gauss system omitting μ and κ. Why not omit the electrostatic system altogether? The sum total of our loss would be a fund of examination questions and a source of confusion as to what is intended when one of our most prominent physicists tells us that the charge of an electron is so many "units." The dielectric constant (we object to our author's "dielectric capacity") of air or other material would then appear to be what it really is—a thing the value of which has to be determined by experiment like its density, elasticity, or any other property.

Ohm's law, electromotive-force, and potential difference are always stumbling blocks. We should not deliberately blind our students to more than one-half of the phenomena by telling them that the current must flow from high potential to low potential; that a current must be flowing if two parts of a conductor are at different potentials; that a current cannot flow unless there is a potential difference; and that the P.D. is equal to the product of the resistance and current. When restricted to the proper cases, all these statements are quite true; but not a single one of them is always true, and the first and last are not even true in the majority of instances. We have only to consider what takes place in the battery branch of a circuit; in a homopolar dynamo; in a copper ring while a magnet is being thrust symmetrically into it, or in an ordinary electric motor, to see how badly we treat our students when we saturate them with these ideas, which they must later unlearn if they continue the subject.

In this book we have "resistance" in chapter 24, "Ohm's law" in chapter 25, and "Joule's law" in chapter 35. Surely the essential thing about resistance is that it causes a generation of heat when a current flows, and these two laws are merely different ways of looking at the same physical fact. A true understanding of electromotive force would at once show that this is the case, and that the ultimate result of both laws is that the property of a given conductor which we call its "resistance" is a constant under certain conditions.

Again, we greatly object to the common practice of dragging in Ohm's law in connection with the magnetic circuit. Since the reluctance of the iron parts is not independent of the flux, even the mathematical analogy is very imperfect. There is no *real* analogy at all, for in the magnetic case nothing flows, and there is no continual generation of heat while the flux exists. A comparison with Hooke's law about stress and strain would be much more sensible.

Bearing in mind that it is intended to be a beginners' book, and that much detail is therefore not to be expected in the more advanced and technical portions, these are really the best; indeed, the last two chapters give excellent summaries of the leading facts about the discharge of electricity through gases and about electrical oscillations. DAVID ROBERTSON.

OUR BOOKSHELF.

Lehrbuch der vergleichenden Mikroskopischen Anatomie der Wirbeltiere. Edited by Prof. Dr. A. Oppel. VII. Teil, *Sehorgan,* by Dr. V. Franz. Pp. x+417. Price 18 marks. VIII. Teil, *Die Hypophysis Cerebri,* by Dr. W. Stendell. Pp. x+168. (Jena: G. Fischer, 1913–14.) Price 8 marks.

WE have on former occasions expressed a high opinion of the "Comparative Microscopic Anatomy of Vertebrate Animals," now appearing under the editorship of Prof. Oppel. The parts here noticed (Nos. 7 and 8) deal with the eye and pituitary body, and maintain the high standard set by the earlier parts. In systematising our present knowledge of the various forms assumed by the eye in vertebrates, Dr. Franz has utilised more than 650 papers published in recent scientific journals, and in the light of his own researches grouped a multitude of facts together, so that his text and numerous illustrations form a consecutive treatise as well as a most valuable encyclopædia for reference. He describes the minute structure of each part of the eye in turn—the retina, vitreous body, pecten, choroid, ciliary body, etc., tracing the variations undergone by each throughout the ramifications of the kingdom of vertebrate animals. The opening chapter deals with the visual cells of amphioxus; the closing one with the structure of the eye of species in which the sense of sight has been impaired or lost from disuse.

Dr. Walter Stendell's monograph on the pituitary body is of particular value at the present time. Until some thirty years ago this apparently unimportant structure was regarded as merely an interesting morphological puzzle. Our estimate was suddenly changed in 1886, when Dr. Pierre Marie discovered that the remarkable disease he described under the name of acromegaly was accompanied by a pathological enlargement of the pituitary body. It was then realised that what was supposed to be merely a small vestigial organ had a direct power of regulating and influencing the growth of the body. Embryologists, morphologists, physiologists, and pathologists then concentrated their attention on it, and the results of their labours may be seen in Dr. Stendell's pages, particularly in his long bibliographical list. We are glad to note he gives due prominence to the pioneer researches of Sir Edward Schäfer and of Prof. P. T. Herring.

Thresholds of Science. Astronomy. By C. Flammarion. Pp. xi+191. (London: Constable and Co.) Price 2*s.* net.

THE name of the author provides a guarantee of the soundness of the principles and the accuracy of the details expounded in this elementary introduction to astronomy by the eminent French astronomer. The book is essentially one for young readers, and the subject-matter is presented in a manner both lucid and interesting. The numerous illustrations are good, and aptly illustrate the text.

Commencing with the physical conditions of the earth, its motion and the resulting phenomena are treated at length, special attention being paid to the functions of the sun. A survey of the heavens with the constellations follows, and our relation to the "fixed stars" is made plain. The members of the solar system are treated individually, and their relations to each other in the system are efficiently illustrated. While dealing with the moon M. Flammarion introduces an interesting feature in a revue of the various mythical "Journeys to the Moon." The book concludes with a brief discussion of comets, nebulæ, and star clusters.

Although, as we are told in a footnote, "M. Flammarion naturally uses French measures" throughout the book, and the equivalents of the kilogram and kilometre are given, it would probably have been better had our own system of units been employed. The exercise in mental arithmetic required to obtain an estimate of the magnitude involved is very liable to break the continuity of thought, especially among the class of readers for whom the book is intended.

Bacon's New Contour Wall Map of Scotland. Scale, 1:316,800, or 5 miles to one inch. Size 48 by 60 in. (London: G. W. Bacon and Co., Ltd.) Price 16*s.*

THIS new edition of a well-known wall map will be welcomed in schools. It is drawn on a conical projection with true meridians of longitude and errorless parallels 55° 30′ and 58° north latitude. The main orographical features are shown in the familiar shades of green and brown, and sea depths in blue tints. The lettering is such that it does not interfere with the scheme of colouring, and the railways, which are shown in red, are easily followed. The map can be obtained mounted and varnished with rollers to hang on the wall, or mounted with eyelets and cut to fold.